COLORADO
CERTIFIED CROP ADVISER

PERFORMANCE OBJECTIVES

2019-2020

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INTRODUCTION

The CCA performance objectives for Colorado cover a wide variety of topics in the areas of nutrient management, soil and water management, integrated pest management, crop management and state regulations concerning the use of fertilizer and pesticides. Crop advisers should be knowledgeable in these areas. Many of the Colorado performance objectives overlap the national objectives. Consequently, some seemingly important subjects may have been omitted from the Colorado performance objectives if they were covered adequately in the national objectives. Overlap with national performance objectives is inevitable in some areas.

Colorado certified crop advisers should be familiar with the crops listed in the box below. Hereafter, they will be referred to as "major Colorado crops." Crops grown on smaller acreages, such as fruit crops, onions and other vegetables, are not included even though they are very important locally.

Major Colorado Crops

Alfalfa	Sorghum
Barley	Sugarbeets
Corn	Sunflowers
Drybeans	Wheat
Potatoes	Forages
Millet	

The Colorado Certified Crop Adviser Performance Objectives are outlined in this document. They delineate the knowledge and skills that are considered important for crop advisers working in Colorado. Certified crop advisers should be able to apply their knowledge of each of the performance objectives to practical field situations.

Individuals taking the Colorado Certified Crop Adviser's exam should know the National Performance Objectives as well as the performance objectives outlined in this document.

NUTRIENT MANAGEMENT

A. Basic Concepts of Soil Fertility

1.1 Describe how soil management and irrigation practices affect nutrient availability, uptake, and loss.

1.2 Differentiate total nutrient content of soils and the available nutrient content reported on soil test reports.

1.3 Explain the causes of uneven soil nutrient distribution within a field and how such distribution may impact crop yields.

B. Nitrogen

1.4 Describe the characteristic N deficiency symptoms in crops and the periods of maximum N uptake.

1.5 List the mobile and volatile forms of nitrogen ions.

1.6 Describe how the carbon:nitrogen ratio of crop residues and organic amendments influence nitrogen availability.

1.7 Explain the agronomic, economic and environmental consequences of over- and under-application of nitrogen fertilizer.

1.8 Describe the advantages and disadvantages of nitrification and urease inhibitors.

1.9 Explain how to adjust N fertilizer recommendations for N credits associated with manure and other organic waste, legumes, crop residues, organic matter, irrigation water NO_3 and residual soil N.

1.10 List the information needed to assess N leaching risk.

C. Phosphorus

1.11 Describe the characteristic P deficiency symptoms in crop plants.

1.12 Explain how each of the following affect soil fixation of fertilizer P and its availability to plants:

- < soil pH
- < lime content
- < placement method
- < form of phosphorus applied

1.13 Describe the environmental consequences of excess phosphorus to surface water quality and identify management practices which minimize potential problems.

1.14 List the situations where an assessment of P runoff risk is appropriate.

D. Potassium and the Secondary Nutrients

1.15 Describe the general deficiency symptoms of potassium, magnesium, and sulfur in plants.

1.16 List the conditions where potassium, magnesium and sulfur are most likely to be deficient.

1.17 Calculate the irrigation water contribution of sulfur in relation to crop need.

E. Micronutrients

1.18 List the most frequently deficient micronutrients in Colorado and the most commonly affected crops.

1.19 List the general symptoms of Fe and Zn deficiencies and explain how to sample plant tissue and soils to determine micronutrient needs.

1.20 List the common methods and materials for correcting crop micronutrient deficiencies.

F. Fertilizer Forms and Application

1.21 Identify the principal fertilizer application methods, the conditions under which each method is preferred and precautions to be taken.

1.22 Define the term fertilizer grade and calculate amounts and rates of commonly used fertilizers needed to meet specified soil test recommendations.

1.23 List the advantages and disadvantages of each of the following fertilizer materials for different soils, crops, and tillage systems:

— anhydrous ammonia
— diammonium phosphate (DAP)
— urea
— monoammonium phosphate (MAP)
— urea-ammonium nitrate (UAN)
— chelated vs inorganic micronutrients

1.24 Describe situations where variable rate technology (VRT) may be used to increase economic returns to producers.

1.25 Describe acceptable sources of plant nutrients for organic crop production.

G. Organic Waste Management

1.26 Calculate a manure credit to adjust both N and P fertilizer recommendations.

1.27 Describe the potential environmental implications of applying manure on frozen or saturated soil, sloping land, or on land adjacent to surface waters.

1.28 Explain how manure storage and application method affects N content and availability.

1.29 Describe proper manure sampling and sample-handling procedures.

1.30 Explain the nutrient management plan requirements of the Confined Animal Feeding Operation permit regulations for animal waste application on crop lands.

H. Soil Testing and Plant Analysis

1.31 Describe the standard methods for soil sampling and handling and the effect of the following factors on soil test results and fertilizer recommendations:

- depth of sampling
- number of cores per composite sample
- soil variability within a field
- areas in fields to be avoided

1.32 Describe standard methods for tissue sampling of the major Colorado crops for nutrient deficiency diagnosis with respect to:

- plant part to sample
- stage of growth
- handling of samples

1.33 Interpret soil test and tissue analysis reports to make economically and environmentally sound fertilizer recommendations.

I. Regulations

1.34 Explain the state requirements regarding on-farm storage, mixing and loading of fertilizers and pesticides.

1.35 Describe the principles of wellhead protection and the steps necessary to comply with local wellhead protection ordinances.

1.36 List the major nutrient management components of a comprehensive nutrient management plan (CNMP).

SOIL AND WATER MANAGEMENT

A. Soil Physical Properties

2.1 Describe how the following soil properties influence crop production and soil management:

- Soil porosity
- Bulk density
- Structure
- Texture
- Organic matter content

2.2 Identify factors that influence soil structure; describe how structure can be damaged and how it can be maintained or improved.

2.3 Identify factors that influence soil organic matter content; describe how organic matter content can be decreased, and how it can be maintained or improved.

B. Soil Water

2.4 Describe how the following soil properties affect irrigation management:

- Water holding capacity
- Infiltration rate
- Drainage
- Slope
- Salinity

2.5 Know the approximate water holding capacity of common soil textures (i.e., loamy sand, loam, clay loam).

2.6 Explain how soil salinity and percent coarse fragment volume affect water availability to plants.

2.7 Know the approximate plant available water of soil textures (i.e., loamy sand, loam, clay loam)

2.8 List the causes and effects of soil salinity and sodicity. Explain how to measure and manage soil salinity and sodicity.

2.9 Describe appropriate reclamation of saline and sodic soils such as:

- Leaching
- Amendments
- Irrigation management

1.1 C. Irrigation Management

2.10 Explain the concepts of:
- Evapotranspiration (ET)
- Seasonal water requirement
- Critical growth stages
- Maximum allowable depletion

2.11 Describe how to monitor soil moisture status by:
- Feel
- Using resistance blocks
- Using a tensiometer

2.12 Describe the common procedures for irrigation scheduling:
- Checkbook
- Probe
- Feel method
- Soil moisture status

2.13 Identify the environmental consequences of poor irrigation efficiency and uniformity.

2.14 Describe the advantages and disadvantages of the following irrigation methods:
- Surface – furrow
- Surface – surge
- Sprinkler
- Drip

2.15 Describe crop management under limited or restricted irrigation.

1.2 D. Soil Erosion Control and Residue Management

2.16 Identify factors affecting soil erosion by wind and water.

2.17 Describe practices to control wind and water erosion.

2.18 Know how polyacrylamide (PAM) works to decrease soil erosion.

2.19 Know under what site conditions would using polyacrylamide (PAM) be most effective at decreasing soil erosion.

E. **Dryland Soil Water Management**

2.20 Describe how the following affect soil water storage under dryland cropping systems:
- Residue management system
- Cropping rotation
- Growth habit of crops grown (comment: e.g., deep- or shallow-rooted)
- Weed management system

2.21 Describe practices that optimize soil water storage under dryland cropping systems.

F. Tillage

2.22 Describe the influence of tillage practices and tillage implements on each of the following:
- Crop residue remaining on the surface
- Incorporation of fertilizer and pesticides
- Soil moisture
- Soil temperature
- Soil structure and compaction
- Pest management
- Nutrient availability
- Soil organic matter

2.23 Explain how the following influence selection and use of conventional tillage, reduced till, and no-till systems.
- Crop rotation
- Soil properties
- Conservation compliance
- Climate

2.24 Describe how increased surface residues will affect the following factors:
- Disease, weed, and insect problems
- Soil temperatures
- Nutrient availability
- Soil moisture storage
- Soil organic matter
- Water infiltration

INTEGRATED PEST MANAGEMENT

A. Integrated Pest Management (IPM)

3.1 Define IPM and list the major IPM strategies. Describe IPM methods available for controlling pests of the major Colorado crops.

3.2 Explain the common prevention strategies to reduce the risk of pest infestation and buildup (i.e., clean seed, planting dates, harvest dates, etc.)

3.3 List the crop and pest information needed to develop and conduct an IPM program.

3.4 Describe how cropping sequence or crop rotation influences the potential for occurrence of pests in crops.

3.5 Explain how to make economically and environmentally sound pest management recommendations for a specific site or situation.

3.6 Describe general scouting, monitoring, and predictive techniques for the major Colorado crops.

3.7 Define action threshold and economic injury level and understand their use in pest management decisions.

3.8 List the principles and limitations of biological, cultural, mechanical, chemical, and genetic tools for pest management.

3.9 Explain the relationship between pest management practices and development of pest resistance to pesticides.

3.10 Describe how record-keeping is used to verify whether pest management strategies used have had the desired effect.

3.11 Describe how crops with insect resistance and herbicide tolerance traits can be incorporated into a pest management program.

B. Weed Management

3.12 Explain the principles of managing common weeds of Colorado. For example:

Summer annuals

— foxtail spp.
— pigweed spp.
— kochia
— wild-proso millet
— nightshade spp.
— Palmer amaranth

Winter annuals

— tansy mustard / flixweed
— cheat grasses (Bromus spp.)
— jointed goatgrass
— blue mustard
— horseweed (marestail)

Perennials

— leafy spurge
— Canada thistle
— field bindweed
— Russian knapweed

Biennials

— diffuse knapweed
— musk thistle
— scotch thistle

3.13 Describe the impact that weeds may have in established forages and pastures as compared to grain crops.

3.14 Identify weeds in alfalfa or grass hay which are poisonous or may cause mechanical injury to livestock.

Poisonous

— western whorled milkweed
— cocklebur seeds and seedlings
— waterhemlock & poison hemlock
— jimsonweed
— white or purple locoweed
— larkspur
— houndstongue
— arrowgrass
— showy milkweed
— lupine

Mechanical Injury

— sandbur
— wild oats
— downy bromegrass
— foxtail barley
— cocklebur
— Russian thistle
— needlegrass

3.15 Explain how new weed species are introduced and how existing weed species are spread.

3.16 List examples of physical, cultural, biological and chemical weed control.

3.17 Be familiar with weeds that have confirmed herbicide resistance in Colorado (www.weedscience.org).

3.18 Plan appropriate perennial and annual weed management programs in no-till and reduced-till production.

3.19 Explain the principles of the Colorado Noxious Weed law and how it mandates the following actions for controlling noxious weeds:
- Prevention
- Containment
- Eradication

3.20 Understand how and when to apply control strategies for compliance with Colorado's Noxious Weed Law.

C. Insect Management

3.21 Explain typical effective methods for managing Colorado's common crop insect and mite pests. For example:

— alfalfa weevil
— corn rootworms
— Colorado potato beetle
— European corn borer
— greenbug
— Mexican bean beetle
— psyllids
— corn spider mite complex
— western bean cutworm
— armyworms
— army cutworm
— pale western cutworm
— grasshoppers
— cereal aphids
— Russian wheat aphid
— onion & flower thrips
— potato leafhopper

3.22 Describe insect sampling and monitoring techniques and how to utilize these for integrated pest management of common insect pests of Colorado crops.

3.23 Explain the process of parasitism by parasitoids and infection by insect pathogens, and recognize the potential impact of predators, parasitoids and pathogens on pest insects and mites.

3.24 Explain the principles of protecting beneficial insects, including honeybees, in crop fields.

3.25 Identify common beneficial insects and their potential impact on crop pests.

— lady beetles
— ground beetles
— damsel bug
— honey bees
— parasitic wasps
— lacewing
— predatory mites

3.26 List the influences of the following practices on insects and mites:

— early or late planting
— early or late harvest
— tillage
— weed control
— crop rotations
— variety selection
— irrigation
— fertilization
— volunteer control

3.27 Describe how to establish refugia to prevent insects from developing resistance to plant incorporated protectants (eg. Bt or other insecticidal toxins).

D. Plant Pathogen and Disease Management

3.28 Describe typical effective methods for managing Colorado's common crop pathogens and diseases. For example:

Alfalfa

— fungal leaf spots and rust
— stem nematodes
— verticillium wilt
— phytophthora root rot

Corn

— viruses
— smuts and rusts
— stalk rot
— damping off and other seedling blights
— Goss's wilt
— stubby root, sting, and root-knot nematodes

Potato

— early blight
— potato leaf roll virus
— late blight
— rhizoctonia and scab
— bulb and root-knot nematodes

Small Grains

— wheat streak and other viruses
— rusts
— take-all and dryland root rot
— smuts
— stunt and root lesion nematodes

Drybeans

— bacterial leaf blight
— rust
— fusarium root rot
— halo blight
— white mold
— root lesion nematodes

Sugarbeets

— cyst nematodes
— powdery mildew
— rhizomania
— cercospora

Sunflowers

— red rust
— rhizopus head rot

3.29 Identify environmental and host factors related to disease development.

3.30 Identify symptoms commonly associated with diseases and the plant damage caused by nemotodal, bacterial, fungal and viral plant pathogens.

3.31 Describe the steps needed to differentiate plant diseases from weather damage, environmental stress, air pollution injury, herbicide toxicity, insect feeding, mechanical damage, and nutrient deficiencies or toxicities.

3.32 Describe the major categories (biological, chemical, cultural, genetic, physical, regulatory) of plant pathogen control and examples of control measures that fall into each of these categories.

3.33 List the major categories of pesticides (bactericides, fumigants, fungicides, nematicides) used in controlling plant pathogens.

3.34 Be able to relate specific disease examples to effectiveness of control by foliar and seed treatment chemicals, and soil fumigation.

E. Pesticides and the Environment

3.35 Describe how pesticide movement in soil and into surface or groundwater may be influenced by the following:

- < soil texture
- < cation exchange capacity (CEC)
- < organic matter
- < soil erosion and erosion control practices
- < depth to water table
- < precipitation, irrigation, and runoff
- < pesticide adsorption
- < pesticide degradation and persistence
- < pesticide application method, rate and timing.

3.36 Describe practices that reduce potential water contamination and plan an appropriate pest management program in vulnerable areas where pesticides with ground or surface water label advisories may contaminate water.

3.37 Explain the procedures used to triple-rinse pesticide containers.

3.38 Distinguish between pesticide spray and vapor drift. List the factors that cause each type of pesticide drift and describe practices to avoid both.

3.39 List common methods used to protect non-target organisms.

F. Pesticide Application and Equipment Calibration

3.40 Explain how to find and use information found on the pesticide label to determine proper pesticide storage, handling and dosage.

3.41 Describe the possible effect of carrier pH on some pesticide products.

3.42 Describe the possible effect of temperature on pesticide storage.

3.43 List the variables that determine the application rate for sprayers and granular applicators.

3.44 Describe the importance of application timing on pest control efficiency.

3.45 Explain the procedures used to calibrate broadcast sprayers and granular applicators and the methods used to adjust output.

3.46 Determine the amount of pesticide to add to the spray tank of a calibrated sprayer.

3.47 Describe how to select pesticides that can be applied by chemigation.

3.48 List the safety requirements of the Colorado Chemigation Act.

3.49 Determine the amount of pesticide to add to a chemigation system and know how to calibrate an injection pump.

3.50 Describe the personal protective equipment needed to handle pesticides safely.

3.51 Explain the proper procedures for applying, handling, storing and transporting pesticides.

3.52 Differentiate restricted use and general use pesticides.

3.53 Describe the appropriate carrier requirements for pesticide applications and how it effects the efficacy of the product.

G. Regulations

3.53 Explain the appropriate procedures for disposing hazardous and non-hazardous pesticide waste.

3.54 List the main provisions of the Worker Protection Standard for worker and handler safety.

3.55 Describe situations where the Worker Protection Standard requires advance notification of pesticide application.

3.56 List the post-application notification requirements of the Worker Protection Standard.

3.57 List the Worker Protection Standard elements required at the Central location.

3.58 Understand the Worker Protection Standard provisions for agricultural consultants as they apply to the Restricted Entry Interval (REI).

3.59 List the circumstances where the Worker Protection Standard requires posting of treated areas.

3.60 List the required components for pesticide recordkeeping and know how long application records must be kept.

3.61 Be able to distinguish between Federal and Colorado (state) pesticide recordkeeping requirements.

3.62 Use a pesticide label to determine proper application rate and precautions.

3.63 Describe the circumstances when deviations from the pesticide label are allowed.

3.64 Explain who must be a licensed private or a commercial certified pesticide applicator in Colorado.

3.65 Know the requirements for using Section 18 exempt and Section 24C products.

CROP MANAGEMENT

A. Crop Adaptation

4.1 Know the relative nutrient and water requirements of the major Colorado crops.

4.2 Describe the specific climatic and soil conditions that influence crop selection and production strategies for the major Colorado crops.

B. Cropping Systems

4.3 List the agronomic and economic considerations in making crop rotation decisions involving the major Colorado crops.

4.4 Describe how differences in water use efficiencies affect crop management decisions.

4.5 List similarities and differences among various cropping systems under irrigated and dryland conditions in Colorado.

4.6 List the advantages and disadvantages of single-crop systems and crop rotations.

4.7 Explain the advantages and limitations of using cover crops and trap crops.

4.8 List the advantages and limitations of organic farming in Colorado.

4.9 Explain how cropping system and residue management influence pest management decisions.

C. Seeding Factors

4.10 Describe the factors influencing planting date, seeding depth, seeding rate, row spacing, and re-plant decisions of the major Colorado Crops.

4.11 Calculate seeding rates and plant populations.

4.12 Explain the value of inoculation of legume seed and the situations when it should be recommended.

4.13 Describe how pure, live seed (PLS) affects germination, seeding rates, and crop growth.

4.14 Explain the value of testing seed for germination and purity.

4.15 Describe the major criteria for selection of crop varieties and hybrids.

D. Crop Growth and Development

4.16 Explain the factors that influence winter hardiness of perennial forages and winter wheat.

4.17 Explain the effects of fertility management practices on vegetative and reproductive growth.

4.18 Calculate growing degree days and relate the growing degree day concept to crop development.

4.19 Describe how the water needs of crops change during crop growth and development.

4.20 Compare and contrast rooting patterns of the major Colorado crops.

4.21 Explain the consequences of heavy rain, pesticide, hail, frost, drought, and wind damage to plant growth and crop yield of the major Colorado crops; and relate the amount of crop damage to the stage of crop development.

4.22 Explain the consequences of weed pressure to plant growth and crop yield of the major Colorado crops.

E. Harvest Factors

4.23 Describe the optimum stage at which to harvest the major Colorado crops, and understand consequences of harvesting too early or too late.

4.24 Explain how to determine physiological maturity of the major Colorado crops.

4.25 Describe effects on subsequent crops of harvesting fields with excessive soil moisture.

4.26 List the advantages and disadvantages of baling, grazing or chopping crop residues and incorporation of residue into the soil.

4.27 Explain the potential consequences of post-frost harvest of alfalfa and forage sorghum.

4.28 Know typical dryland and irrigated yields for the major Colorado crops.

4.29 List common test weights of the major Colorado grain crops